APPENDIX V. ASSIGNMENT OF GAS FURNACE EFFICIENCY IN THE BASE CASE

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APPENDIX V: ASSIGNMENT OF GAS FURNACE EFFICIENCY IN THE BASE CASE

This appendix describes DOE's method for assignment of non-weatherized gas furnace (NWGF) efficiencies to sample households in the base case.

V.1 NOPR Method

For the NOPR analysis, DOE derived the base case furnace assignment from data that GAMA provided on the percentage of furnace sales in each State that are condensing furnaces.[1] DOE combined the State-level GAMA data into Census divisions, and then assumed condensing gas furnaces were installed in households solely on the basis of climate.

DOE assumed that the heating degree-day (HDD) profile correlates with the AFUE shipment profile. For each Census division, the AFUE of the furnace for each sample household was assigned by determining the percentile associated with the household's HDD and matching it to the same percentile in the AFUE profile. In other words, all households in the division sample were rank ordered from highest HDD to lowest, and furnace efficiencies were assigned to them in order from highest to lowest, to match the distribution of efficiencies in the division.

Figure V.2.1 illustrates this approach for Census division four (West North Central). This Figure shows the percentile of households and the distribution of AFUE in the shipments. First, the LCC spreadsheet samples a household, determines the HDD percentile and assigns an AFUE from the corresponding percentile. For example, for a household with 8000 HDD (100 percentile), the assigned AFUE was 96%. For a household with HDD of 6000, the HDD percentile was 68% and the assigned AFUE is 92%. Consequently, all households in this Census division having HDDs greater than 6000 were assigned furnaces with efficiencies of at least 92 AFUE. Households with HDD below 4800 (dashed horizontal line) were assigned furnaces with AFUE below 90%.

V.2 Revised Analysis for Final Rule

Upon review, DOE determined that the assumption that the existing (and future) market for condensing furnaces (absent a standard) was likely to be concentrated in the coldest states was not an accurate reflection of the state-by-state sales data that GAMA provided. DOE found that in several Census divisions for which the average HDD is greater than 6000, some states within the division have average HDD lower than 6000.[a] Therefore, in Steps 1 and 2 of the revised analysis, DOE split each of these Census divisions into two climate zones—states with average HDDs of above 6000 and below 6000. Using the state-level shipments data provided by GAMA, DOE matched the household HDD percentile with the AFUE percentile *within each climate zone rather than for the whole division* to assign the efficiency of the base case furnace. This matching of HDD and AFUE by climate zone is illustrated in Figures V.2.2 and V.2.3.

[a] These are Census divisions 3, 4, 8, and 9.

Figure V.2.2 illustrate the changes in Step 2 for the revised assignment of furnace AFUE for households in Census division four in the climate zone with HDDs of 6000 or higher. This Figure shows that 38% (dashed horizontal line) of shipments in this climate zone are non-condensing and 62% of the shipments in this climate zone are condensing, based on state-level GAMA data. Accordingly, in Step 3, DOE assigned condensing furnaces to 62% of the households in this climate zone with highest HDDs (these are the household above the dashed line in Figure V.2.2). (After adjusting for the RECS household weights, this appears as 63.7% in Table V.2.1. The small number of households in the RECS survey causes the percentiles to differ slightly from the GAMA percentiles.)

DOE used the same approach for households in Census division four in the climate zone with HDDs below 6000 HDD (see Figure V.2.3). In this climate zone, 24% of shipments are condensing furnaces. Accordingly, DOE assigned condensing furnaces to 24% of the households in this climate zone with the highest HDDs (these are the household above the dashed line in Figure V.2.3). (After adjusting for the RECS household weights, this appears as 25.8% in Table V.2.1. The small number of households in the RECS survey causes the percentiles to differ slightly from the GAMA percentiles.)

Table V.2.1 shows the percent of total NWGF that were condensing furnaces in the NOPR analysis and in the revised analysis for the final rule. For those states having more than 6000 HDD (subsets of some divisions), the NOPR analysis assumed that almost all households with more than 6000 HDD had condensing furnaces. In contrast to the NOPR analysis, the revised analysis has lower shares of condensing furnaces in most states with more than 6000 HDD and higher shares of condensing furnaces in most states with less than 6000 HDD. The results of the revised analysis correspond to the shares of condensing furnaces reported in GAMA state-level data.

Table V.2.1 Percent of Condensing Furnaces in Census Divisions (NOPR and Final Rule Analysis)

Division	GAMA Shipments (2015)*	NOPR Analysis			Final Rule Analysis	
		National	>= 6000 HDD	< 6000 HDD	>= 6000 HDD	< 6000 HDD
1	65.2%	65.2%	100.0%	70.5%	66.1%	
2	51.2%	51.2%	100.0%	50.2%		52.6%
3	50.7%	50.7%	100.0%	28.7%	52.6%	51.0%
4	54.3%	54.3%	100.0%	31.0%	63.7%	25.8%
5	32.6%	32.6%		32.6%		34.5%
6	32.8%	32.8%		32.8%		34.6%
7	9.0%	9.0%		9.0%		11.5%
8	23.5%	23.5%	49.9%	0.0%	30.5%	17.4%
9	30.3%	30.3%	100.0%	27.1%	27.8%	32.4%
10	43.4%	43.4%	98.3%	0.0%	44.9%	
11	14.5%	14.5%	100.0%	12.1%		16.8%
12	7.1%	7.1%		7.1%		9.6%
13	5.5%	5.5%		5.5%		8.0%
USA	35.6%					

* The GAMA 2003 shipment data were adjusted in two ways: first, on the assumption that the share of condensing furnaces increases over time from 31.4% in 2003 (original GAMA data) to 35.6% in 2015; and second, to account for household sample weights by division in RECS 2001 (small numbers of households in some divisions causes a coarser representation).

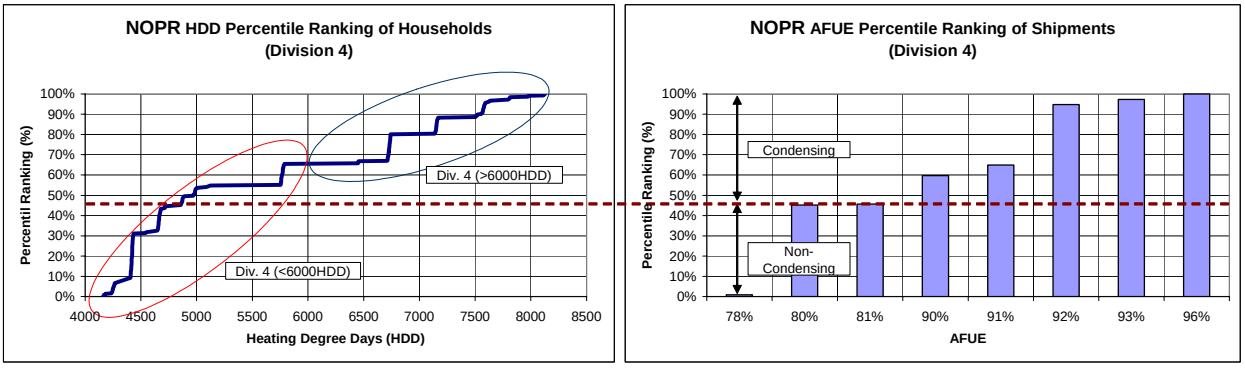

Figure V.2.1 NOPR Analysis HDD Percentile Ranking of Households and AFUE Percentile Ranking of Shipments (Division 4)

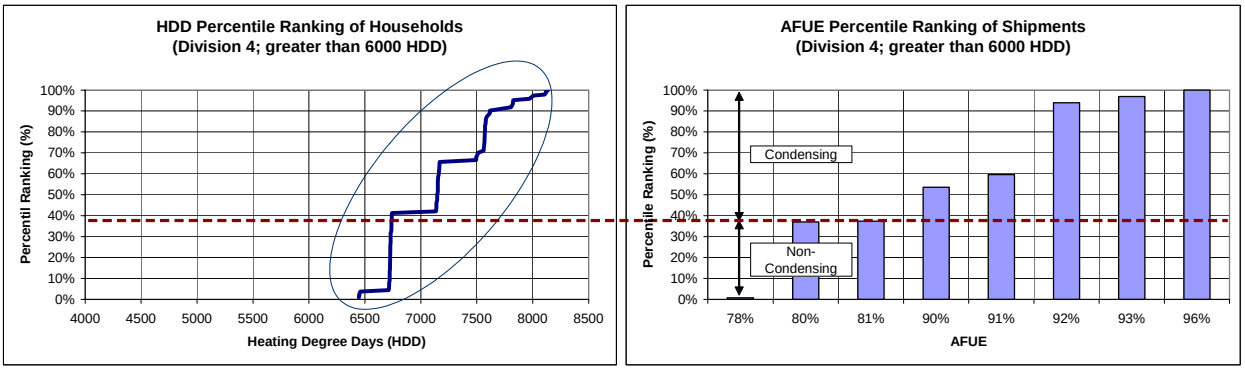

Figure V.2.2 HDD Percentile Ranking of Households and AFUE Percentile Ranking of Shipments (Division 4; greater than 6000 HDD)

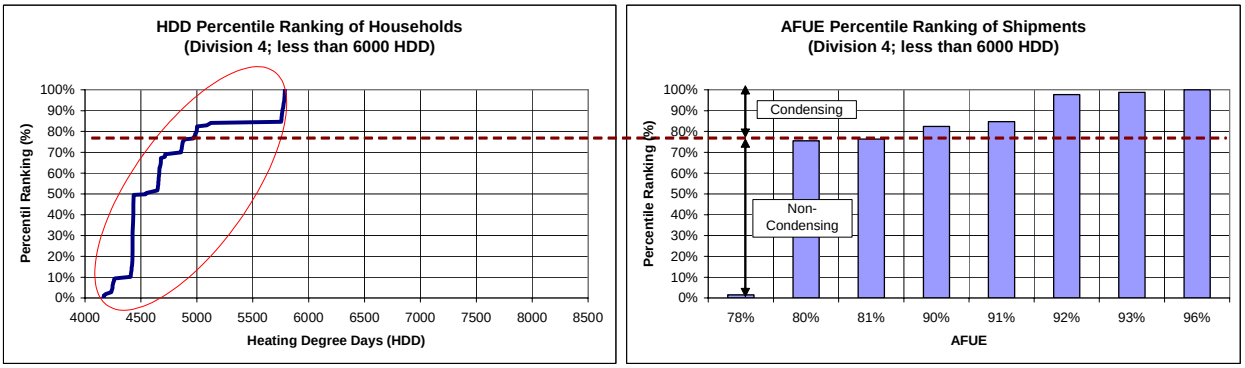

Figure V.2.3 HDD Percentile Ranking of Households and AFUE Percentile Ranking of Shipments (Division 4; less than 6000 HDD)

REFERENCES

1. Gas Appliance Manufacturers Association (GAMA), Updated Shipment Data for Residential Furnaces and Boilers, *personal communication.* April 25, 2005.